

Claims

What is claimed is:

1. A three way valve comprising:

a valve body having a first passage, a second passage and a third passage disposed therein, and including a first seat and a second seat;

a valve member at least partially positioned in said valve body, and being moveable between said first seat and said second seat;

said first passage being open to said third passage across said first seat when said valve member is in contact with said second seat;

said second passage being open to said third passage across said second seat when said valve member is in contact with said first seat; and

at least one of said first passage, said second passage and said third passage including a flow restriction relative to a flow area across at least one of said first seat and said second seat.

2. The valve of claim 1 wherein one of said first passage and said third passage has a first flow restriction relative to a flow area across said first seat; and

one of said second passage and said third passage has a second flow restriction relative to a flow area across said second seat.

3. The valve of claim 2 wherein said first flow restriction includes a cylindrical passage segment; and

said second flow restriction includes a cylindrical passage segment.

4. The valve of claim 2 wherein said first flow restriction has a smaller flow area than said second flow restriction.

5. The valve of claim 1 including an electrical actuator with a moveable portion attached to said valve member; and  
a spacer having a predetermined one of a plurality of thicknesses.

6. The valve of claim 5 wherein said moveable portion includes an armature, and a stationary portion includes a stator; and  
said armature having an air gap relative to said stator defined by a thickness of said spacer.

7. The valve of claim 5 wherein said electrical actuator includes a male/female electrical socket connector.

8. The valve of claim 5 wherein said electrical actuator includes a piezo.

9. The valve of claim 5 including a biaser operably positioned to bias said valve member toward said first seat.

10. The valve of claim 1 wherein said third passage is a portion of a closed volume.

11. The valve of claim 10 wherein said closed volume is at least partially defined by at least one volume reducing surface feature.

12. The valve of claim 1 wherein said valve body includes an unobstructed flow passage therethrough; and

said second passage is fluidly connected to said flow passage.

13. The valve of claim 1 wherein a travel distance of said valve member between said first seat and said second seat is less than 50 microns.

14. The valve of claim 13 wherein said travel distance is between 25 and 35 microns.

15. The valve of claim 1 wherein said valve body includes a lift spacer separating a first seat component and a second seat component; a travel distance of said valve member between said first seat and said second seat being defined by a thickness of said lift spacer; and said lift spacer has a predetermined one of a plurality of thicknesses.

16. The valve of claim 1 wherein said valve member has a separate guide clearance with each of a first seat component and a second seat component.

17. The valve of claim 1 wherein said valve member has a pair of spherical valve surfaces with a common center.

18. An electro-hydraulic actuator comprising a source of high pressure liquid; a low pressure liquid reservoir; a three way control valve with a high pressure passage fluidly connected to said source of high pressure liquid, a low pressure passage fluidly connected to said low pressure liquid reservoir, and including a closed control pressure volume and a valve member trapped to move between a high pressure

seat and a low pressure seat, and said closed control pressure volume including a control passage;

a moveable piston with a control hydraulic surface exposed to fluid pressure in said control pressure volume;

an electrical actuator operably coupled to said valve member;

said low pressure passage being open to said control pressure volume across said low pressure seat when said valve member is in contact with said high pressure seat; and

said high pressure passage being open to said control pressure volume across said high pressure seat when said valve member is in contact with said low pressure seat; and

at least one of said high pressure passage, said low pressure passage and said control passage including a flow restriction relative to a flow area across one of said low pressure seat and said high pressure seat.

19. The actuator of claim 18 wherein

one of said low pressure passage and said control passage has a first flow restriction relative to a flow area across said low pressure seat; and

one of said high pressure passage and said control passage has a second flow restriction relative to a flow area across said high pressure seat.

20. The actuator of claim 19 wherein said closed control pressure volume is at least partially defined by at least one volume reducing surface feature.

21. The actuator of claim 20 wherein said first flow restriction includes a cylindrical passage segment; and

said second flow restriction includes a cylindrical passage segment.

22. The actuator of claim 21 wherein said three way valve includes a lift spacer separating an upper seat component and a lower seat component;

a travel distance of said valve member between said low pressure seat and said high pressure seat being defined by a thickness of said lift spacer; and

said lift spacer has a predetermined one of a plurality of thicknesses.

23. The actuator of claim 22 wherein said electrical actuator includes an armature attached to said valve member; and

a stator separated from said armature by an air gap defined by a spacer, which has a predetermined one of a plurality of thicknesses.

24. The actuator of claim 23 including a biaser operably coupled to bias said valve member toward contact with one of said high pressure seat and said low pressure seat.

25. The actuator of claim 24 wherein said first flow restriction has a smaller flow area than said second flow restriction.

26. The actuator of claim 25 wherein said valve member has a separate guide clearance with each of said upper seat component and said lower seat component.

27. The actuator of claim 26 wherein said electrical actuator includes a male/female electrical socket connector.

28. The actuator of claim 27 wherein said piston is a portion of a member that includes an opposing hydraulic surface, which is exposed to fluid pressure in said high pressure passage, in opposition to said control hydraulic surface.

29. The actuator of claim 28 wherein said member is moveable between a first position and a second position; and  
a biaser operably positioned to bias said member toward one of said first position and said second position.

30. A method of operating a three way control valve, comprising the steps of:

fluidly connecting a first passage to a third passage across a second valve seat at least in part by positioning a valve member in contact with a first seat;

restricting liquid flow from said third passage to said first passage at least in part by locating a first flow restriction in at least one of said first passage and said third passage, wherein said first flow restriction is restrictive relative to a flow area across said second seat;

fluidly connecting a second passage to said third passage across said first seat at least in part by moving said valve member into contact with said second seat;

restricting liquid flow from said second passage to said third passage at least in part by locating a second flow restriction in at least one of said second passage and said third passage, wherein said second flow restriction is relative to a flow area across said first seat.

31. The method of claim 30 including a step of hastening pressure changes in said third passage at least in part by defining said third passage with at least one volume reducing surface feature.

32. The method of claim 31 including a step of differentiating flow rates through the valve at least in part by making said first flow restriction more restrictive than said second flow restriction.

33. The method of claim 32 including a step of reducing a valve response time at least in part by supplying excessive power to an electrical actuator attached to said valve member.

34. The method of claim 33 including a step of reducing leakage at least in part by blocking said second passage to said third passage when said valve member is in contact with said first seat; and  
blocking said first passage to said third passage when said valve member is in contact with said second seat.